DOCUMENT RESUME

ED 081 675 SO 006 098

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TITLE Simulated Agribusiness.
PUB DATE [Apr 73]
NOTE 18p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Agribusiness; Agricultural Education; Agricultural Skills; Agricultural Supplies; Agriculture; Business Education; Decision Making Skills; *Economic Education; *Educational Games; Farm Management; Field Crops; Games; Higher Education; Land Use; Marketing; Planting; Role Playing; Secondary Grades; *Simulation

ABSTRACT

"Simulated Agribusiness" is designed to provide the student with a role playing situation dealing with the complexities and problems of modern agriculture. It is a competitive game played on a hypothetical mid-latitude diversified farm in a capitalistic system. The player is faced with a series of decisions which will determine his success or failure, such as land acquisition, crop selection, optional investment, soil bank, crop insurance, and commodity features. Rules and examples of these decisions are described. The decision-making process is discussed, along with techniques for adjusting the game to students of varying levels of sophistication. Tables indicate hypothetical expenses, yield per acre, prices, yield and price variations, and disasters. A financial sheet is provided to simplify organization and computation. A teaching package accompanies the game. (Author/KSM)

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"Simulated Agribusiness"

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SP006098

A serious educational problem for students in our increasingly urbanized society is their lack of familiarity with modern agriculture. One technique for overcoming this deficiency is through the use of simulations or educational games. "Simulated Agribusiness" is designed to provide the student with a role playing situation dealing with many of the complexities and problems of modern agriculture. Although most of the agricultural parameters are artificial, the basic design of the simulation provides an exposure to: the spectrum of decisions a farmer must make; the importance of understanding various crop parameters; some of the environmental problems in agriculture; techniques for controlling yield fluctuations and increasing yield; dynamic aspects of the agricultural market; the role of government in modern agriculture; and, some of the financial complexities and problems of commerical agriculture.

THE SIMULATION

"Simulated Agribusiness" is a competitive game that can be played by any number of individuals or groups on a hypothetical mid-latitude diversified farm in a capitalistic system. The primary objective is to earn as much money as possible without going bankrupt. The player is faced with a series of decisions which will determine his success or failure such as land acquisition, crop selection, optional investments, soil bank, crop

insurance, and commodity futures. The only equipment requirements are a writing instrument and at least one six sided die. A financial sheet is provided to simplify organization and computation. The game should be played a minimum of 10 repetitions (representing ten years) to be realistic. The player is provided with fifty thousand dollars ($50,000) of initial capital.

Land Acquisition

1.) The player selects the quantity and quality of land he wishes to buy or rent from among class A at $900 an acre, class B at $300 an acre, or class C at $100 an acre. Productivity of each land class is outlined in the table of yields (Table II) and the player can buy or rent any quantity or combination he desires. Cost is computed by multiplying the number of acres by the price of that land. The player must pay 40% of this figure as a down payment. To compute yearly mortgage, the player divides the remainder (total cost of land minus 40%) by 10, which is recorded under 2(a) on the financial sheet for 20 years. This procedure simulates a twenty year mortgage at approximately 7 3/4% interest and is repeated for each new purchase of land. However, a player can only sell land to another player.

Example: a player wishes to buy 30 acres of class A land and 50 acres of class C land.

$$\begin{aligned} 30 \times 900 &= \$27{,}000 \\ 50 \times 100 &= \underline{\$\ 5{,}000} \\ &\quad \$32{,}000 \end{aligned}$$

down payment equals $32,000 X .40 = $12,800
mortgage payments equal $19,200 ÷ 10 = $1,920 per year for 20 years.

2.) The player's property taxes are determined by taking 3% of the total value of his land and recording it under 2(d) at the end of

each year.

3.) If the player does not wish to purchase land, he may rent it. The rental agreement specifies the player can only raise tomatoes and strawberries on class A land; rice and corn on class B land; alfalfa and oats on class C land; or, any combination of these crops. The owner and the player equally divide all operational costs and profits (50 - 50). However, the player does not have to pay any down payments, mortgage or property taxes and all of his operational expenses (except living expense) are shared with the owner.

Planting

1.) The player selects the crop or combination of crops he wishes to plant based on the tables of expenses, yield, and prices (Tables I, II, III). The player then multiplies the number of acres planted by the required expenses listed under Table I for each crop and records his expenditure under 2(b) on the financial sheet.

Example: the player wishes to raise 50 acres of strawberries at $180 per acre, and 100 acres of wheat at $20 per acre.

His required costs are 50 X $180 = $9,000
100 X $ 20 = $2,000
$11,000

2.) The player may select some optional investments for his operation. These include: 1.) fertilizer; 2.) insecticides and pesticides; 3.) irrigation; and, 4.) union labor. There are two advantages in utilizing the optional investments. First, each investment will increase yield by 10% (40% if all four are utilized) and secondly if a certain disaster is encountered (see Table IV) there is no

loss.

Example: the player listed above with 50 acres of strawberries and 100 acres of wheat utilizes the optional investments of irrigation and insecticides. He will increase his costs listed under 2(c) on the financial sheet by

$$\begin{array}{rl} 50 \times (\$45 \times 2) = & \$4,500 \\ 100 \times (\$\ 5 \times 2) = & \underline{\$1,000} \\ & \$5,500 \end{array}$$

This additional expenditure will increase his yield by 20% and he will be protected (no loss) in case of drought or insect blight. However, he is not protected against a labor strike or soil depletion. If there is a strike or soil depletion, the entire crop is a failure. The optional expenses will equal the required expenses if the player elects to utilize all four optional investments.

3.) The player has the option of taking out crop insurance to guard against a disaster. The player may take out any amount of insurance he desires, provided it does not exceed his total cost (subtotal of item 2 on the financial sheet). The total insurance premium must be divided by the number of crop types on each different land class to determine the amount of insurance on each crop. The cost of the insurance is 15% of the total premium per year. For example, if a player desires $10,000 worth on two crops, he must pay $1,500 to be recorded under 2(f) on the financial sheet which will provide for $5,000 coverage on each crop.

4.) The player may put his land into the soil bank program which pays $160 an acre for class A land; $55 an acre for class B land; and, $25 an acre for class C land. In addition, the yield will

be increased 10% the following year, but only the following year, even if the land has been in the soil bank more than one year.

5.) The yearly living expense for each player is $5,000 to be recorded under 2(e) on the financial sheet. All expenses are on a "pay as you go" basis and must be deducted from the cash on hand (item 1 minus item 2 on financial sheet) before income can be computed.

Growing Season

1.) The player must roll the dice to determine any disasters that might be encountered during the growing season (see Table IV). A player with one die may roll it twice and add the score to determine his disaster roll. The player must roll for each crop on each different class (quality) of land but only once. A player cannot have 100 acres of wheat on class C land and roll for 20 acres at a time. If the player rolls a 6, 7, or 8 he has encountered no problems and can continue on, whereas a 4, 5, 9, 10 or 11 mean he has encountered the disaster that corresponds with that particular number (see Table IV). If the player has utilized the optional investment that corresponds with that disaster such as: fertilizer for soil depletion (#4); pesticides for bugs (#5); irrigation for drought (#9 or #11), or, union labor for strike (#10) there is no penalty and the player continues. However, if he has not utilized the optional investment and he rolls a 4, 5, 9, 10 or 11, his crop is a failure and he may collect his insurance if he has it. A roll of 2, 3, or 12 is a failure for the year regardless of

improvements unless he has purchased insurance.

2.) After the player has completed his disaster roll, he rolls one die for each crop in each class of land to determine crop yield. The table of yields (Table II) lists the yield that corresponds to each die number: 1 or 2 is less than average; 3 or 4 is the average expected yield, and 5 or 6 is above average.

Example: if the player has 30 acres of strawberries on class A land and 100 acres of wheat on class B land, he will roll the die twice. His first roll for strawberries is a 5 which is equal to 300 bushels per acre on class A land times 30 acres for a yield of 9,000 bushels of strawberries and his second roll for wheat is a 1 which equals 115 bushels per acre on class B land times 100 acres for a total yield of 11,500 bushels of wheat which is recorded in the yield column under 3(d) on the financial sheet. In addition, if the player has utilized optional investments, he will increase each yield by 10% per investment or 40% when all four have been utilized.

Price

1.) Prior to determining the price received for a crop, the player has the option of selling his crop by way of commodity futures (Table III). If the player decides to sell on the open market he must roll the die for each crop regardless of where it was grown. The market prices are also listed in Table III by die roll. As with yield; a 1 or 2 pays a price less than the average, and a 3 or 4 pays the average, while a roll of 5 or 6 pays above

the average. For example, if the player has raised strawberries and wheat and he rolls a 4 for strawberries, he will receive $1.50 per bushel and he rolls a 6 for wheat he will receive $ .60 a bushel for wheat. This figure(s) is recorded under the price column under 3(c). (The optional investments have no effect on price)

Computation

1.) After determining the yield and the price of each crop, the player multiplies the total yield times the price for each crop and totals the income for all crops. The player records this figure under 3(d) crop income on the financial sheet. At this point, the player must figure his total income by adding all figures listed under item 3. He must then add his income to his remaining cash on hand and continue to the next year. If the player has a deficit (negative figure) he is bankrupt. If a player sees in advance that he will be bankrupt he may wish to sell land to another player to provide enough income to prevent bankruptcy.

2.) In the final computation at the end of the designated playing period (10 years), the player should include all equity accumulated by adding all down payments and mortgage payments to his total net profit. However, a player cannot add mortgage payments on land he has sold to another player.

DISCUSSION

The first decision a player must make pertains to the quality and quantity of land he wishes to purchase. Since each class of land has the same profit potential relative to its cost when properly utilized, the selection of a particular land class is not critical. Thus, the major consideration for the player is that he purchase enough land to make a profit in excess of his non-agricultural expenses. A secondary consideration is that some players will wish to keep some of their initial capital in reserve in case of a bad first year which would limit the amount of land they can purchase. The major advantage of renting land is that the player has considerably more cash to invest in operational expenses and can plant more acres. However, the renter will rarely earn more than the land owner in the long run when equity is included.

The most critical decision in "Simulated Agribusiness" is planting the right crop on the right class of land. An analysis of land cost and expenses as opposed to yield and prices reveals: alfalfa, oats, millet, and wheat are designed for class C land; potatoes, rice corn, and cotton produce best in class B land; while, lettuce, soy beans, tomatoes and strawberries are most productive in class A land. It is very difficult to make a profit unless the player establishes this relationship. Of the four crops that are designed for each class of land, each crop has certain yield and price variations ranging from conservative to speculative.

A player wishing to speculate should select lettuce, cotton or millet. A more conservative player should select soy beans, potatoes, or wheat where there is little chance of going bankrupt.

Some players may wish to utilize the soil bank which provides a small profit and will increase yield the subsequent year. The soil bank actually provides slightly more profit for class C land than the others. Although commodity futures provide little advantage to the conservative player, futures can be very profitable for the speculator. If the speculator has a high yield and does not wish to risk a low price, he can assure himself of a good profit by selling his crop as a commodity future.

Once the crop(s) and area have been selected, the player is faced with a series of additional alternatives. The optional improvements provide increased yield and protection against disaster but are more expensive. Most students will wish to utilize the optional improvements because of the increased yield. If the player does exercise all four optional improvements, it is usually to his benefit not to take out insurance because the player has only 8 1/3% chance of crop failure. If the player elects to use less than all four optional improvements, his hierarchy of choices should be: irrigation of 16 2/3% coverage; pesticides 13 8/9% coverage; and, fertilizer and union labor 11 1/9% coverage.

It is almost imperative that a player who has not utilized the optional improvements have insurance since there is a 55% chance of crop failure. The insurance allows a sophisticated

player an opportunity to increase profit. If the player has an expensive crop and a cheap crop insured to the maximum, he should not utilize optional improvements on the cheap crop and hope for a disaster which would give him an insurance payment greater than he could realize from the sale of the crop.

The game is designed to be conceptually and mathematically complicated. Some instructors may wish to simplify some of the parameters in order to utilize the game with less advanced students. Three means of simplification include: 1.) elimination of one class of land such as class B land; 2.) use of only three yield and price variations rather than five by having a die roll of one or two represent the figure that is now listed under 1 and a 5 and 6 represent the figure that is now listed under 6; and, 3.) reduce the number of crops. Since cotton, lettuce, potatoes, wheat, soy beans, and millet represent the maximum and minimum in price and yield variation, it is recommended that these crops be retained if there is to be an elimination of some crops. Table V is an example of a combination of all three variations.

Some instructors may wish to add additional dimensions to the simulation as the students become more proficient. For example, the mortgage used in the game is 7 3/4% for twenty years, which could be adjusted higher or lower depending on the down payment. The instructor might have the players compute their income tax on Internal Revenue Service form F.

The determination of the price provides several possibilities for altering the game. Each player determining his own price was employed in the game because of the different paces at which students work particularly when it involves mathematics. Some instructors may wish to roll one price per crop per year for the entire class which would be a more realistic means of determining price. A very realistic means of establishing price would be to create a free market based on the amount of production by each player in the class. This could be done by establishing production norms and crop production that exceeds the norm will drop the price of that crop while crop production that is below the norm will increase the price. With some adjustments in the design some instructors could have the class use actual yields and prices for selected crops.

Table I

Expenses

CROP	REQUIRED EXPENSE	OPTIONAL IMPROVEMENTS
1. Alfalfa	$20 per acre	$5 per acre per improvement
2. Corn	$60 " "	$15 " "
3. Cotton	$60 " "	$15 " "
4. Lettuce	$180 " "	$45 " "
5. Millet	$20 " "	$5 " "
6. Oats	$20 " "	$5 " "
7. Potatoes	$60 " "	$15 " "
8. Rice	$60 " "	$15 " "
9. Soy beans	$180 " "	$45 " "
10. Strawberries	$180 " "	$45 " "
11. Tomatoes	$180 " "	$45 " "
12. Wheat	$20 " "	$5 " "

Table II

Yield Per Acre

CROP	CLASS OF LAND	DIE ROLL				
		1	2	3 & 4	5	6
1. Alfalfa	A	100	150	205	250	300
	B	60	95	130	175	200
	C	40	60	80	100	120
2. Corn	A	200	215	225	235	250
	B	140	150	160	170	180
	C	60	65	70	75	80
3. Cotton	A	115	165	215	265	315
	B	80	120	160	200	240
	C	35	50	65	80	95
4. Lettuce	A	120	180	240	300	360
	B	70	105	140	175	210
	C	35	50	70	90	105
5. Millet	A	100	150	200	250	300
	B	65	105	130	165	195
	C	40	60	80	100	120
6. Oats	A	190	200	210	220	230
	B	105	115	130	145	155
	C	65	70	80	90	95
7. Potatoes	A	200	210	220	230	240
	B	140	150	160	170	180
	C	55	60	65	70	75
8. Rice	A	125	175	215	265	315
	B	80	120	160	200	240
	C	30	45	60	75	90
9. Soy beans	A	210	225	240	255	270
	B	115	125	135	145	155
	C	50	60	70	80	90
10. Strawberries	A	120	180	240	300	360
	B	65	95	130	165	195
	C	30	45	60	75	90
11. Tomatoes	A	210	225	240	255	270
	B	100	115	130	145	160
	C	50	60	65	70	80
12. Wheat	A	190	200	210	220	230
	B	115	120	130	140	145
	C	70	75	80	85	90

Table III

Prices

CROP	DIE ROLL					COMMODITY FUTURES
	1	2	3&4	5	6	
1. Alfalfa	.40	.45	.50	.55	.60	.45
2. Corn	.50	.75	1.00	1.25	1.50	.95
3. Cotton	.50	.75	1.00	1.25	1.50	.95
4. Lettuce	.75	1.15	1.50	1.85	2.25	1.40
5. Millet	.25	.37	.50	.62	.75	.45
6. Oats	.25	.37	.50	.62	.75	.45
7. Potatoes	.80	.90	1.00	1.10	1.20	.95
8. Rice	80	.90	1.00	1.10	1.20	.95
9. Soy beans	1.20	1.35	1.50	1.65	1.80	1.40
10. Strawberries	1.20	1.35	1.50	1.65	1.80	1.55
11. Tomatoes	.75	1.05	1.50	1.85	2.25	1.40
12. Wheat	.40	.45	.50	.55	.60	.45

Table IV

Disaster Chart

DICE NUMBER	DISASTER
2	hail storm (failure)
3	hail storm (failure)
4	soil depletion
5	bug blight
6	no problems
7	no problems
8	no problems
9	drought
10	labor strike
11	drought
12	flood (failure)

Table V

Crop	Expenses Required	Optional	Class of Land	Yield 1&2	Yield 3&4	Yield 5&6	Price 1&2	Price 3&4	Price 5&6
cotton	180	45	A	210	240	270	1.20	1.50	1.80
			C	50	70	90			
lettuce	180	45	A	120	240	360	.75	1.50	2.25
			C	35	70	105			
millet	20	5	A	100	200	300	.25	.50	.75
			C	40	80	120			
potatoes	60	15	A	200	220	240	.80	1.00	1.20
			C	55	65	75			
soy beans	60	15	A	115	215	315	.50	1.00	1.50
			C	35	65	95			
wheat	20	5	A	190	210	230	.40	.50	.60
			C	70	80	90			

Financial Sheet

_____(1) Cash on hand

\- _____ minus down payment

_____ subtotal (1)

Land class		Acres		Cost
A. 900	X	_____	=	_____
B. 300	X	_____	=	_____
C. 100	X	_____	=	_____
total land cost	=			_____

\- _____(2) expenses

_____ (a) mortgage

_____ (b) required expenses

_____ (c) optional investments

_____ (d) property taxes

_____ (e) living expenses

_____ subtotal expenses

_____ (f) insurance payments

_____ subtotal (1 - 2)

_____ total expenses

\+ _____ (3) Income

_____ (a) land sold

_____ (b) soil bank

_____ (c) insurance claims

_____ (d) crop income (see below)

_____ total

_____ carry over

CROP INCOME

yield	(yield+opt.inv.)	X acres =	total yield	X price =	return
_____		X _____ =	_____	X _____ =	_____
_____		X _____ =	_____	X _____ =	_____
_____		X _____ =	_____	X _____ =	_____
_____		X _____ =	_____	X _____ =	_____